Available Online at www.e-iph.co.uk
Indexed in Clarivate Analytics WoS, and ScienceOPEN

E-B Environment - Behaviour Proceedings Journal

CSSR 2017

https://www.amerabra.org; https://fspu.uitm.edu.my/cebs; https://www.emasemasresources.com
4th International Conference on Science & Social Research
The Pines, Malacca, Malaysia, 06 -07 December 2017

e-IPH e-International Publishing House Ltd., United Kingdom

Performances in English Proficiency Course with Students' Ability in Answering Higher Order Thinking Skills Questions

Rafidah Rasol[1], Nur Syimal'ain Azmi[2], Sharipah Ruzaina Syed Aris[2], Wan Razarinah Wan Abdul Razak[2]

[1] School of Biological Sciences, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor Malaysia.
[2] Faculty of Education, Universiti Teknologi MARA, 42300 Kampus Puncak Alam, Selangor Malaysia

rafid738@uitm.edu.my, syimalainazmi@gmail.com, sruzaina@uitm.edu.my, razarina408@uitm.edu.my,
Tel of 1st Author: +603-55435733

Abstract

This study investigates how English writing skills' effect on the students' performance in answering Higher Order Thinking (HOT) questions in Molecular Biology final examination. The samples consisted of Biology degree students from two consecutive semesters in UiTM Shah Alam and UiTM Jengka. Mean percentage of students performance was obtained and correlated with marks obtained in English course. The two campuses demonstrated different correlation between students' achievement in English and their ability in answering HOT questions. The results of this study are hoped to assist biology educators in crafting appropriate teaching approaches, as well as in strengthening English language proficiency.

Keywords: Higher Order Thinking Skills; Molecular Biology; English Proficiency; Bloom's Taxonomy.

DOI: https://doi.org/10.21834/ebpj.v5iSI1.2314

1.0 Introduction

Molecular Biology is considered a challenging subject as it involves deep conceptual understanding of complex Biology processes at the molecular level and advanced molecular techniques. It incorporates biochemistry and genetics in a living system. In UiTM, students from Bachelor of Science (Hons) Biology are required to take Molecular Biology (BIO615) during semester four and semester five depending on their modes of entry. There are two different types of entry mode, which are from the Diploma of Science or Foundation in Science and Science Matriculation. Different levels of students' achievement generally produce other methods of entry. Mlambo (2011) stated that factor that has a significant effect on the students' academic performance in various settings is entry qualification. Adebayo and Tinuola (2014), in their study, depicted that students have better and consistent grades with higher entry qualifications than those with lower-level qualifications. However, in this study, different modes of student's entry and their relation in answering HOTS questions in BIO615 were not highlighted.

2.0 Literature Review

English is used in all programmes offered in UiTM whether Science and Technology based or the Social Science-based (Arsad *et al*., 2014). Therefore, in the Faculty of Applied Sciences where BIO615 is offered, the medium of instruction in lectures, laboratory sessions and tutorials used in English. In order to strengthen the students' command in English, those from Bachelor of Science (Hons) Biology are required to take three English subjects namely Preparatory College English (ELC400), English for Academic Reading (ELC450) and English for Academic Writing (ELC 550) for the first three semesters of their degree-level study. ELC550, which is the highest English code taken by Biology students, has course learning outcomes (CLO) focusing on the ability to analyse and respond critically to academic texts and integrate information to prepare an academic text outline besides being able to present them orally. Furthermore, students

eISSN: 2398-4287 © 2020. The Authors. Published for AMER ABRA cE-Bs by e-International Publishing House, Ltd., UK. This is an open access article under the CC BYNC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/). Peer–review under responsibility of AMER (Association of Malaysian Environment-Behaviour Researchers), ABRA (Association of Behavioural Researchers on Asians) and cE-Bs (Centre for Environment-Behaviour Studies), Faculty of Architecture, Planning & Surveying, Universiti Teknologi MARA, Malaysia.
DOI: https://doi.org/10.21834/ebpj.v5iSI1.2314

must have a certain level of Malaysian University English Test (MUET) before entering the first-degree program. Therefore, sufficient exposure to thinking, conversing and writing in English is hoped to assist UiTM degree students in delivering their answers in English during the examination. For those whose first language is not English (Wardlow, 1999), there is a need to polish or increase their skills in this language since English proficiency is vital for completing their studies in English medium institutions.

Malaysia is lagging in preparing adequate utilisation to enhance HOTS in learning whether in highereducation or secondary education (Chinedu *et al.,*2015). Moreover, learning objectives in training and curricular focus tremendously on the lower levels of the taxonomy, including comprehension and knowledge. This problem is in the radar of the Ministry of Education. HOTS is defined as the capability to apply knowledge, skills and value in reasoning, reflection, problem-solving, decision making, innovating and creating something new. Zohar and Dori (2003) referred HOTS to a thinking process that consists of complicated procedures and needs to be based on various skills such as analysis, synthesis, comparison, interference, interpretation, assessment and inductive and deductive reasoning to be employed in solving unfamiliar problems. Through myriad forms of the thinking process, students are capable of finding the answer or accomplishing target goals (Budsankom *et al.,* 2015). Therefore, HOTS is the skills used by students to apply and evaluate the knowledge, which require deep conceptual understanding (Gulistan *et al.,* 2015; Zoller, 1993).

Quality of student learning is significantly impacted by the improvement of assessments in education (Entwistle & Entwistle, 1992). Hence, Crowe et al. (2008) stated that a more comprehensive tool is needed for undergraduate biology instructors so that they can easily evaluate students' knowledge, guide the development of teaching approaches and enhance students' metacognition in biological science as developed by Blooming Biology Tool (BBT). In Bloom's Taxonomy, there are six categories of cognitive skills ranging from lower-order skills that require less cognitive processing to higher-order facilities as well as deeper learning and a greater degree of cognitive processing (Adams, 2015). Teachers in Malaysia are expected to include the HOTS element to foster deeper thinking activities among students in the 21st century to respond to the vision of the Ministry of education (Sulaiman *et al.,* 2017). Charif (2010) stated that educators should think about methods that fit in higher level of thinking and problem solving since it is necessary for students today to think critically to face real world problems. Marin and Halpern (2011) confirmed that critical thinking can help shaping the foundation of students' early adult life for them to enter the society as professional adults. There are various techniques that can be done to implement HOTS in learning. One of the ways is by constructing open-ended questions for building understanding, which will motivate further conversation among students, thus promoting higher-level thinking (Huerta & Jackson, 2010). Magsino (2014) opted for problem-based learning to enhance HOTS in Marine Biology class. Similar to this situation, HOTS were asked in BIO615 final examination according to Bloom's Taxonomy classification and Table of Specification Test (TOS), which a tool to ensure the reliability, validity, fairness and consistency of final examination. According to Fives and DiDonato Barnes (2013), test blueprint or TOS is a table that assists teachers in teaching by aligning the objectives, instruction and assessment that are usually used for traditional summative test. When constructing or selecting a test, a teacher can use TOS as tool to verify their professional judgment. Due to the observation of high failure rate in BIO615 in these two campuses, this study aimed at identifying the relationship between the students' performance in ELC550 and their scores in answering HOTS in BIO615 final examination.

3.0 Methodology

Research Design: The researcher adopted descriptive research in this study to answer the research questions and applied quantitative research method to acquire the data. Descriptive research is related to the description of characteristics of a particular individual or a group.

HOTS identification: HOTS questions in BIO615 final examination from Semester Sept-Jan 2016 and Mac-July 2016 were chosen. These HOTS questions were identified according to classification of Bloom's Taxonomy and Table of Specification Test. Bloom's Taxonomy Indicator version 3 developed by Curriculum Affairs Division, UiTM was used in assisting the identification of HOTS questions into the three levels known as analysis, synthesis and evaluation. The percentages of marks for HOTS questions for these two semesters were 10-30% specifically for Year 3 students. This translated to 18 marks in the Sept-Jan 2015 semester and 12 marks from semester Mac-July 2016. The questions asked are displayed in Table 1.

TABLE 1: HOTS Questions asked in BIO615 final examination.

Examination	Question Number	Question	Marks	Accumulative marks
December 2015	1 (b)	Chromosome organisation allows a 2 m long DNA to be squeezed into a 2 μm cell nucleus. **Explain** the other four levels of chromosome organisation that builds up from your answer in 1a).	8	18
	3	During screening of blue-white transformants in the molecular cloning process, X-gal is added into the screening medium. **Justify** the significance of X-gal addition.	6	
	6 (a)	You have just isolated the chloroplast genome DNA of mungbean *(Vigna radiata)* with the size of 150 kb. You planned to build a genomic library of around 9-20 kb restriction digests. **Determine** the appropriate vector and explain your choice.	4	
June 2016	2(b)	The pBR322 plasmid, first created in the late70s became less popular after the introduction of the pUC plasmid. **Explain** the	3	15

	reason for the abandonment of the pBR322 plasmid and the importance of the new characteristic found in the pUC plasmid.	
6(b)	Discovery of a new species of beetle in Borneo rainforest revealed that its mRNA is different by having a poly (G) tail instead of poly (A) tail as per eukaryotic organisms. **Describe** how you can construct a cDNA library of this beetle. Include a labelled diagram to help visualise your answer.	12

The questions utilised the verbs describe, explain, justify and determine. Question 1(b) from December 2015 and 2(b) from June 2016 both utilised the verb explain, which can be used in higher level questions (C5 or C6) in this context. The long essay question 1(b) required the students to visualise the complex chromosome structural organisation and relate it to its purpose to recall that information. Meanwhile, Question 2(b) from June 2016 involved comparison and connection between the characteristics of pBr and pUC plasmids as well as the disadvantage of the former plasmid. As for Question 6(b) from semester June 2016, describe was used in a higher level question (C6) as the students need to understand the concept of cDNA library right from the first process of priming for the poly (A) tail as the question was twisted from a normal condition. Therefore, the evaluation type question (C6) needs the synthesis of knowledge and ability in visualising the process to answer it. Question 3 from December 2015 permits the student to give reason for their action when facing a situation related to a scientific experiment. Finally, Question 6(a) from December 2015 paper let students to decide (C6) if given a condition in an experiment.

Students' performance scoring: Student marks in answering selected HOTS questions in BIO615 were obtained from the Examination's unit for the Semester Sept-Jan 2015 and Mac-July 2016 final examination. The marks for the identified HOTS questions were tabulated together with results of ELC550 accordingly.

Research Instrument: The HOTS questions utilised by this study were based on Bloom's Taxonomy that focuses on three levels that require creative and critical thinking followed by analysis, synthesis and evaluation. Meanwhile, the Table of Specification Test (TOS) was used to identify the questions as HOTS questions in the BIO615 final examination.

Population and Sampling: The population of this study comprised 61 students in UiTM Jengka, Pahang and 51 students from UiTM Shah Alam in the Faculty of Applied Sciences. The sample of population for this study includes students from the Bachelor of Science (Hons.) Biology who are taking BIO615 as one of their subjects in semester 4 or 5 depending on their entry either from the Diploma in Science, Science Foundation or Science Matriculation. Therefore, the sampling was purposive sampling in which the researcher acquired the marks of the ELC and HOTS score from Examinations' unit for December 2015 and June 2016.

Data Analysis: The data collected was analysed and synthesised using Statistical Package for Social Science (SPSS 17.0) to observe the significance between students' performance in answering HOTS questions in the BIO615 final examinations and its association with their ELC 550 marks

4.0 Results

Results shown in 1 a) and b) include the correlation between ELC marks and the respective students' ability to answer HOTS question in BIO615 final examination in UiTM Shah Alam. Both semesters of Sept-Jan 2016 and semester Mac-July 2016 showed a weak relationship with R values of 0.341 and 0.275, respectively. Results shown in 1 c) and d) display the correlation between ELC marks and the respective students' ability to answer HOTS question in BIO615 final examination in UiTM Jengka. In semester Sept-Jan 2016, Fig 1 c) shows the correlation value of R=0.526 considered as intermediate relationship, whereas the R value for semester Mac-July 2016 [Fig 1 d)] was slightly lower (0.193) but was still categorised as having a weak relationship.

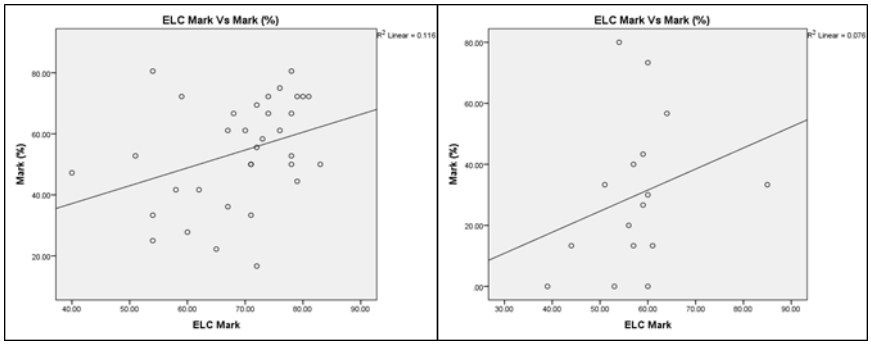

Fig 1a) Fig 1b)

Correlation of ELC marks with BIO615 final examination marks in students from
Fig.1: a) UiTM Shah Alam campus from Semester Sept-Jan 2016
Fig.1: b) UiTM Shah Alam campus from Semester Mac-July 2016

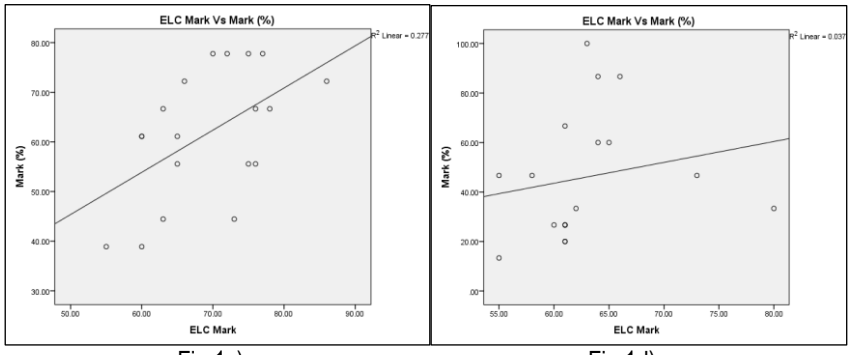

Fig 1c) Fig 1d)

Fig.1: c) UiTM Jengka campus from Semester Sept-Jan 2016
Fig.1: d) UiTM Jengka campus from Semester Mac-July 2016

5.0 Discussion

From the results, it can be deduced that students with better performance in ELC 550 were not necessarily able to answer HOTS in BIO615 final examination as seen in the weak value of most of the relationships. However, for semester Sept-Jan 2016 in UiTM Jengka, the intermediate relationship showed that scorers in ELC550 were better in answering some of the HOTS questions in BIO615 final examination. Stoddart et al. (2002) in their study suggest that science learning and language learning have a reciprocal and synergistic relationship. There was a myriad of formats such as in writing, oral idea deliverance, drawing and creating tables and graph to communicate their understanding of BIO615. Furthermore, low English skills hindered the students from having depth understanding about concepts of this course because they have to interpret it in their mother tongue, which is Bahasa Melayu, before translating it back into English (Hiew, 2012). Therefore, Noor and Azmah (2006) stated that the main source of poor academic performance among students is having low proficiency in English since it can cause students to face difficulties in understanding the basic knowledge, thus contributing to poor written essay (Arsad et al., 2014). Cummin (1991) proved a significant relationship between English reading and writing academic achievement. In addition, most of the reference works and textbooks at the university level are written in English (Noor & Azmah, 2006). Last but not least, students can retain academic information by having a strong language skills including writing and speaking (Huerta & Jackson, 2010).

Another study that is not in line with the results obtained in this study is a study by Sharifah and Syed (2004) that showed significant correlation between the fluency in English language and students to excel in overall academic performances in their study. Besides, Huerta and Jackson (2010) concluded that various media of language such as writing, data tabulation and figure construction in BIO615 can help students in keeping their memory, thus improving their academic performance. International students need to have a TOEFL (Test of English as Foreign Language) while in Malaysia, the local undergraduates require MUET as a prerequisite to pursue degree level. Martirosyan et al. (2015) discussed in their study that there were significant differences in the academic performance of international students with different English language proficiency where the students who scored higher in TOEFL have high GPA, while those who scored lower in TOEFL have low GPA.

BIO615 utilised the normal lecture and laboratory session approach. Oral presentation is compulsory for every semester. In this way, educators can encourage communication skills that would also reflect an individual ability to critically discuss a subject matter. There are a few methods practiced in literature that can enhance critical thinking skills in students. Case-based studies that emphasised on problem solving and discussion had also increased students' abilities to answer application and analysis-type questions in Introductory Biology course (Chaplin, 2009). Secondly, teaching science through inquiry had also promoted HOTS by using scientific research articles. Hugerat and Kortam (2014) administered pre-test and post-test to Biology/Chemistry majors together with an intervention that emphasised on inquiry teaching. Besides leading to positive emotional and cognitive satisfaction, this intervention increased HOTS development among the participants. Moreover, inquiry-based learning had been applied to chemistry laboratory where inquiry-type experiments were given and assessed using proper tools, resulting in improvement of ability in asking scientific questions (Hofstein *et al.,* 2004). In MSU-Balindong High School, chemistry students favoured the HOTS questions as it was interesting, challenging though difficult (Valdez *et al.,* 2013). Problem-based learning was found as an effective instructional strategy within a conventional curriculum that can enhance critical thinking in marine biology (Magsino, 2014). Given these strategies to increase critical thinking skills, it is an approach that can be implemented by BIO615 educators to increase critical thinking skills in the class, therefore overcoming the need to rely on English course alone to inculcate critical thinking skills in Biology students.

6.0 Conclusion

Bachelor of Science (Hons) Biology students in two UiTM campuses have been seen showing a weak relationship between majority of ELC550 marks and their ability to answer HOTS question in BIO615 final examination. Other variables that can be the factors such as entry requirement and instructors' leniency that influence students' achievement should be further examined.

Acknowledgments

The authors gratefully acknowledge Universiti Teknologi MARA in providing the ARAS research grant [Project Number: 600-IRMI/DANA 5/3/ARAS (0053/2016)].

References

Adams, N. E. (2015) Bloom's taxonomy of cognitive learning objectives. *J Med Lib Assoc*, 103(3):152-153.

Adebayo, A. S., & Tinuola, D. A. (2014) Entry Criteria as predictor of Academic Success: A Case of Solusi Universiti, Zimbabwe. *European Scientific Journal*, 10:13.

Arsad et al. (2014) Students' English language proficiency and its impact on the overall student's academic performance: An analysis and prediction using Neural Network Model. *WSEAS Transactions on Advanced in Engineering Education* 1: 44-53.

Budsankom et al. (2015). Factors affecting higher order thinking skills of students: A meta-analytic structural equation modeling study. *Academic Journals* 10 (19): 2639 -2652.

Chaplin, S. (2009) Assessment of the Impact of Case Studies on Student Learning Gains in an Introductory Biology Course. *Journal of College Science and Teaching.* 72 - 79.

Charif, M. (2010) The Effects of Problem Based Learning in Chemistry Education on Middle School Student' Academic Achievement. Beirut: Lebanese American University.

Chinedu, C. C., Kamin, Y., & Olabiyo, O. S. (2015) Strategies for Improving Higher Order Thinking Skills in Teaching and Learning of Design and Technology Education. *Journal of Technical Education and Training* 7 (2): 35 - 43.

Crowe, A., Dirks, C., & Wenderoth, M. P. (2008). Biology in Bloom: Implementing Bloom's Taxonomy to Enhance Student Learning in Biology. *Life Science Education* 7: 368 - 381.

Cummin, J. (1991). Language development and academic learning (pp. 161 -75) In L.M. Malave and G. Duquette (Eds.). Language, Culture, and Cognition. Clevedon, England: Multilingual Matters, Ltd.

Dori, Y.J., Tal, R.T. and Tsaushu, M. (2003) Teaching Biotechnology Through Case Studies-Can We Improve Higher Order Thinking Skills of Nonscience Majors? *Science Education* 87(6) : 767-793

Entwistle, A., & Entwistle, N. (1992). Experiences of understanding in Revising for Degree Examination. *Learn. Instruct*., 2: 1-22.

Fives, H., & DiDonato-Barnes, N. (2013). Classroom Test Construction: The Power of a Table of Specifications. Practical Assessment, Research & Evaluation., Volume 18, Number 3, February 2013.

Gulistan, A. M., Abu, B. N., & Omed, S. A.-A. (2015). Teacher Strategies for Promoting Higher Order Thinking Skills: A Case of Secondary Science Teachers Thinking Skills. *Malaysian Online Journal Educational Management (MOJEM*), 3(4) :16 -30.

Hiew, W. (2012). English Language Teaching and Learning Issues in Malaysia: Learners' Perceptions Via Facebook Dialogue Journal. *Journal of Arts, Science & Commerce* 3(1): 11-19.

Hofstein, A., Shore, K. and Kipnis, M. (2004) Providing High School Chemistry Students with Opportunities to Develop Learning Skills in an Inquiry-type Laboratory:A Case Study. *International Journal of Science Education.* 26(1):47-62.

Huerta, M., & Jackson, J. (2010). Connecting Literacy and Science to Increase Achievement for English Language Learners. *Early Childhood Education Journal*, 38: 205 - 211.

Hugerat, M. and Kortam, N. (2014) Improving Higher Order Thinking Skills among Freshmen by Teaching Science through Inquiry *Eurasia Journal of Mathematics, Science & Technology Education* 10(5):447-454.

Magsino, R.M. (2014) Enhancing Higher Order Thinking Skills in Marine Biology Class through Problem-Based Learning *Asia Pacific Journal of Multidisciplinary Research* 2(5):1-6

Martirosyan, N. M., Hwang, E., & Wanjohi, R. (2015). Impact of English Proficiency on Academic Performance of International Students. *Journal of International Students* 5(1):60 -71.

Mlambo, V. (2011). An analysis of some factors affecting student academic performance in an introductory biochemistry course at the University of the West Indies. *Carribbean Teaching Scholar,* 1(2): 79 - 92.

Noor, A. I., & Azmah, O. (2006). Comparing university academic performances of HSC students at the three art-based faculties. *International Education Journal*, 7(5): 668-675.

Sharifah, K. A., & Syed, M. A. (2004). An Exploratory Study on English Language Proficiency and Academic Performance in The Context of Globalization of Accounting Education. National Accounting Research Journal, Vol. 2 Iss 1, 5571.

Stoddart, T., Pinal, A., Latzke, M. & Canaday, D. (2002). Integrating Inquiry Science and Language Development for English Language Learners. *Journal of Research in Science Teaching*, 39(8): 664687.

Sulaiman,T., Muniyan,V., Madhvan, D., Hasan, R. and Syrene, S.(2017). Implementation of Higher Order Thinking Skills in Teaching of Science. International Research Journal of Education and Sciences (IRJES), 1(1): 1-3.

Wardlow, G. (1999). International students of Agriculture in U.S. institutions precursors to academic success. *Journal of Agricultural Education*, 30:17-22.

Valdez, A., Mangorsi, S., Hambre, V., Magdara, D. and Manalundong, M. (2013) Effects of HOTS Techniques through Modular Instructions in Teaching High School Chemistry in MSU-Balindong High School. *IJEEEE* 3(4):326-329.

Yadav, A., Lundeberg, M., DeSchryver, M., Dirkin, K., Schiller, N.A., Maier, K. And Herreid, C.F. (2007) Teaching Science with Case Studies: A National Survey of Faculty Perceptions of the Benefits and Challenges of Using Cases. Journal of College Science Teaching 37(1):34-38.

Zohar, A. and Dori, Y.J. (2003) Higher Order Thinking Skills and Low-Achieving Students: Are they mutually exclusive? *The Journal of The Learning Sciences.* 12(2):145-181.

Zoller, U. (1993). Are lecture and learning compatible? Maybe for LOCS: unlikely for HOCS (SYM). *J. Chem. Educ.*70: 195 - 197.